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EXAMINER	
RUGGLES, JOHN S	

ART UNIT	PAPER NUMBER
1756	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/663,691	INAO ET AL.	
	Examiner	Art Unit	
	John Ruggles	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 March 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-14 and 16-18* is/are pending in the application.

4a) Of the above claim(s) *5-14 and 16* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,17 and 18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 March 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

In the last submission filed on 3/3/06, claims 1 and 4 are currently amended, claims 2-3 and 15 have now been cancelled, claims 5-14 and 16 remain withdrawn as non-elected, and new claims 17-18 have now been added. Therefore, only claims 1, 4, and 17-18 remain under consideration.

The previous drawings objections numbered (i), (ii), (iii), (iv), and (vi) are withdrawn in view of Applicants' current amendments to the drawings and specification. However, the previous drawings objection numbered (v) has not been addressed by Applicants and is maintained as shown below.

While the previous specifically exemplified objections to the specification numbered (1)-(7) are withdrawn in view of Applicants' current amendments to the specification, examples of further specification objections still remaining are given below.

The previous objection to the claims, the previous rejections under the second paragraph of 35 U.S.C. 112, and the previous rejections under 35 U.S.C. 102 are each withdrawn in view of current claim amendments. The rewritten and new rejections of claims 1, 4, and 17-18 under 35 U.S.C. 103 have been necessitated by Applicants' amendments and are therefore made FINAL.

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because (v) reference character "100" has been used to designate all of (a) the light source unit shown by Figure 1 as described at page 18 line 18 (b) the Si mask substrate (for making a mask supporting member 410 of the mask 400) found in the description at page 41 lines 21-23 (presumably in

reference to Figure 1, Figure 2A, and/or Figure 2B) and (c) the silicon wafer Si (for making a mask supporting member 410A of the mask 400A) found in the description at page 55 line 23 (presumably in reference to Figure 6, Figure 7A and/or Figure 7B).

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

In addition to Replacement Sheets containing the corrected drawing figure(s), Applicants are required to submit a marked-up copy of each Replacement Sheet including annotations indicating the changes made to the previous version. The marked-up copies must be clearly labeled as "Annotated Sheets" and must be presented in the amendment or remarks section that explains the change(s) to the drawings. See 37 CFR 1.121(d)(1). Failure to timely submit the proposed drawing and marked-up copy will result in the abandonment of the application.

Specification

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification

are: (8) at page 6 lines 4-9, "Synthetic quartz which can be produced by use of a special production method can meet exposure light of a wavelength of about 248 nm. However, the transmissivity of it decreases steeply in regard to the wavelength not greater than 193 nm." should be changed (to e.g., --Synthetic quartz, which can be produced by use of a special production method, ~~can meet~~ is transmissive to exposure light of a wavelength of about 248 nm. However, the transmissivity of it decreases steeply ~~in regard to the~~ at a wavelength not greater than 193 nm.--, etc.); (9) at page 7 line 2, "s ping" is clearly misspelled; (10) at page 8 lines 19-23, "light being polarized in a direction perpendicular to the lengthwise direction of the small opening is incident and a case where light being polarized in a direction parallel to the lengthwise direction is incident" should be changed (to e.g., --incident light [[being]] is polarized in a direction perpendicular to the lengthwise direction of the small openings ~~is incident~~ and a case where incident light [[being]] is polarized in a direction parallel to the lengthwise direction ~~is incident~~ of the small openings.--, etc.); (11) at page 8 line 26, "xposure" is clearly misspelled; (12) (a) at page 22 line 16 and also (b) at page 49 line 15, the compound "Si3N" should be corrected to --[[Si3N]] Si_3N_4--, if these changes best represent Applicants' original intentions; and (13) Applicants should also correct all other similar errors to those previously listed and further exemplified above throughout the specification. Note that due to the number of errors, those listed here are merely *examples* of the corrections needed and do *not* represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and

also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Objections

The previous objection to the claims is withdrawn in view of current claim amendments.

Claim Rejections - 35 USC § 112

The previous rejections under the second paragraph of 35 U.S.C. 112 are withdrawn in view of current claim amendments.

Claim Rejections - 35 USC § 102

The previous rejections under 35 U.S.C. 102 are withdrawn in view of current claim amendments.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 4, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Kuroda et al. (US 6,171,730) or Kuroda et al. (US 6,187,482) in view of Alkaisi, M. M. et al. ("Sub-diffraction-limited patterning using evanescent near-field optical lithography", (1999) Applied Physics Letters).

Kuroda et al. '730 teach a near field evanescent light exposure process and a near field exposure apparatus that includes a near field mask having an opaque shading layer with aperture

widths of about 100 nm or less (title, abstract), but preferably in the range of 1-100 nm, as shown by Figures 2A and 2B (col. 5 line 41 to col. 6 line 40). Col. 1 lines 13-25 suggest that the presently used near field ultraviolet (UV) laser light source (instant claim 18) has a wavelength at about 0.1 μm (100 nm) or larger, which is understood to mean that the opaque shading layer aperture width is less than the wavelength of exposure light so that the ratio of the aperture width to the wavelength of exposure light must be between 1 and 1/100, or even smaller. Figures 1A and 1B show close contact between the mask 106 and the resist 107 during exposure (col. 3 lines 58-67 and col. 5 lines 9-24). Figure 2A shows rectangular block form L-shaped slit openings in the opaque shading layer on the near field mask (col. 6 lines 40-42, which reads on the instant claims for resist exposure through a mask opening formed with lengthwise directions extending only in different and mutually orthogonal directions).

Kuroda et al. '482 teach a near field mask for evanescent light exposure and an apparatus for making a pattern using the near field mask (title, abstract). The mask includes a transparent base or substrate 201 and a metallic thin film shading member 203 having minute apertures 204, each having a width < 100 nm, which is small in comparison with the wavelength of exposure light (abstract, Figure 2, col. 4 lines 49-54). Figure 1 shows a laser 101 for projecting laser light 102 for exposure (instant claim 18) towards a mask 106, which is in close contact with a resist 107 during the exposure (col. 4 lines 1-2, 30-32, and 35-36). Figure 3A shows hook-shaped (rectangular block form L-shaped) slit openings 303 having two perpendicular lengthwise directions in the opaque shading layer on the near field mask (col. 8 lines 10-14, which reads on the instant claims for resist exposure through a mask having an opening formed with lengthwise directions extending only in different and mutually orthogonal directions).

Neither Kuroda et al. '730 nor Kuroda et al. '482 specifically teach *[1]* detecting one of the lengthwise directions of the opening and projecting light for exposure of the resist that is polarized in a direction of an angle of approximately 45° with respect to lengthwise mutual orthogonal directions of the mask opening (instant claims 1 and 4).

Alkaisi et al. teach clear and faithful reproduction through a near-field mask having rectangular apertures or openings that are 70 nm wide (which is < 1/5 times the wavelength of incident light). High transmission (intensity of transmitted light) through the mask openings is always achieved for at least one polarization of incident light through the near-field mask as shown by Figure 2(b) (page 3561, left col., fourth full paragraph). Polarization of incident light in the direction perpendicular to the length (in the same direction as the width) of mask apertures (for transverse magnetic (TM) polarization) results in high light transmission through the mask openings to expose a resolved pattern in the top 40 nm of the resist layer (as shown in Figure 3(a) on page 3562, left col., last paragraph), whereas polarization of incident light in the direction parallel to the length of mask openings (for transverse electric (TE) polarization) does not result in a clearly resolved pattern to any depth at all in the resist layer (as shown in Figure 3(b) on page 3562, right col., lines 1-4). Thus, exposure of the resist will be dominated by the well-resolved, high-intensity TM polarization profile (page 3562, right col., lines 4-7).

It would have been obvious to one of ordinary skill in the art at the time of the invention that a process of exposing a resist through a near field mask having an opening formed with lengthwise directions extending in only first and second mutually orthogonal directions (as taught by either Kuroda et al. '730 or Kuroda et al. '482) by linear polarized exposure light aligned in the same direction as the width of the first lengthwise opening direction (such that the

exposure light is polarized at an angle of 90° from the first lengthwise opening direction) on the mask would be expected to cause exposure of the resist that is dominated by a well-resolved, high-intensity polarized profile only under the first lengthwise opening direction on the near field mask (full intensity exposure, as taught by Alkaisi et al.). However, no significant exposure at all would be obtained in the resist under the second lengthwise mutually orthogonal opening direction on the mask (which runs in a direction at an angle of 0° from the direction in which the exposure light is polarized, no intensity exposure, as taught by Alkaisi et al.). In order to achieve a uniform exposure through both of the first and second mutually orthogonal directions of the mask opening, it would have been obvious to one of ordinary skill in the art that the linear polarization of the exposure light should not be aligned with either the first or the second mutually orthogonal directions of the mask opening ***[1]***. In fact, it would logically be expected from the teachings of either Kuroda et al. '730 or Kuroda et al. '482 in view of Alkaisi et al. that the intensity of exposure light on the resist under both the first and second mutually orthogonal directions of the mask opening can be at least nearly equalized when the exposure light is linearly polarized in a direction at an angle of about half-way between 0° and 90° (or approximately 45°) with respect to the first and second lengthwise mutually orthogonal directions of the mask opening ***[1]***. The nearly equalized exposure intensity from the first and second lengthwise mutually orthogonal directions of the mask opening achieved from this exposure light linearly polarized at approximately 45° would be about half-way between the former full intensity under the first lengthwise opening direction for exposure light linearly polarized at an angle of 90° thereto and the former zero intensity under the second lengthwise opening direction for exposure light linearly polarized at an angle of 0° thereto. In practice, it is

well known in the art of resist exposure that the characteristics of the mask must necessarily be determined and utilized to set optical exposure conditions (e.g., for at least the reasons taught by Alkaisi et al., etc.). Therefore, it would also have been obvious to detect the lengthwise mutually orthogonal directions of the mask opening before determining or controlling the exposure light linear polarization (e.g., at an angle of approximately 45° from the lengthwise mutually orthogonal directions of the mask opening, etc.) and intensity on the basis of the detected lengthwise mutually orthogonal directions of the mask opening, in order to ensure the desired degree of uniform exposure in the underlying resist ***[1]***.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Kuroda et al. (US 6,171,730) or Kuroda et al. (US 6,187,482) in view of Alkaisi, M. M. et al. ("Sub-diffraction-limited patterning using evanescent near-field optical lithography", (1999) Applied Physics Letters), further in view of Naya (US 2002/0196420), and further in view of either Matsuura et al. (US 4,566,795), Kato et al. (US 5,726,757), Fujimoto et al. (US 2003/0044730), or Nishikata (US 6,523,748).

Neither Kuroda et al. '730, Kuroda et al. '482, nor Alkaisi et al. specifically teach ***[2]*** detecting one of the lengthwise directions of the mask opening on the basis of an index mark on the mask that bears information for detecting one of the lengthwise directions of the opening (instant claim 17).

Naya teaches a near-field exposure system or apparatus and method for imaging a photosensitive material or resist (title, abstract). In order to ensure sufficient near-field light exposure, the resist 11 is closely contacted to a near-field mask 14 during exposure (as shown in Figure 2, paragraphs [0052, 0057]). When the mask has pattern openings constituted by lines

extending in more than one direction (which encompasses a mask having an opening formed with lengthwise directions extending in plural directions that include first and second mutually orthogonal directions), circularly polarized exposure light (that is polarized in a direction other than those of the opening lengthwise directions on the mask) should be used to prevent uneven exposure or thickening of imaged lines from the mask opening having different lengthwise directions so that a fine pattern in the resist can be formed during exposure [0070]-[0071]. The direction of a linear polarization is optionally adjusted or controlled by a polarizer plate that is rotated to a desired position based on the (detected) direction(s) of lines in the mask opening pattern ([0024], which enables the polarization to be selected in any desired direction with respect to plural lengthwise directions of lines in the mask opening, including first and second mutually orthogonal directions of lines in the mask opening).

Alignment or index marks on a mask to detect the position of the mask (e.g., having openings in predetermined directions, etc.) are very well known. For example, Matsuura et al. teach diagonal index marks oriented at an angle of 45° on a mask, as shown in Figures 17B and 18 (col. 15 lines 35-45). Kato et al. also teach index marks oriented at an angle of 45° on a mask, as shown in Figures 25A-25E (col. 5 lines 5-7 and col. 18 lines 6-12). These index marks are very similar to Applicants' index marks 434, as shown in instant Figure 2A. More specific information can also be recorded in index marks on a mask by the use of characters or symbols of any kind, including a bar code, which is detected by reading the information for identifying details about the mask or the pattern thereon (Fujimoto et al., [0020], [0035]-[0036], [0040]). Nishikata (Figures 2-3, col. 5 line 57 to col. 6 line 7, col. 7 lines 21-47, and col. 9 lines 27-34)

teaches another example of index codes or bar codes on a mask for specific information used to determine or detect details about the mask or the pattern thereon.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention in the method that includes detecting one or more of the lengthwise directions of a mask opening on the mask before determining or controlling the exposure light linear polarization (e.g., at an angle of approximately 45° from the lengthwise mutually orthogonal directions of the mask opening, etc.) and intensity on the basis of the detected lengthwise mutually orthogonal directions of the mask opening (that would have been obvious over Kuroda et al. '730 or Kuroda et al. '482 and Alkaisi et al. for at least the reasons discussed above) to include an index mark on the mask that bears information for detecting one or more of the lengthwise directions of the mask opening (as taught by Matsuura et al., Kato et al., Fujimoto et al., or Nishikata, instant claim 17, ***[2]***), in order to prevent uneven exposure or thickening of imaged lines from the mask opening having different lengthwise directions so that a fine uniformly exposed pattern can be formed in the underlying resist (as taught by Naya).

Response to Arguments

The previous drawings objections numbered (i), (ii), (iii), (iv), and (vi) have now been withdrawn in view of Applicants' current amendments to the drawings and specification. However, the previous drawings objection numbered (v) has not been addressed by Applicants and has therefore been maintained, as shown above.

While the previous specifically exemplified objections to the specification numbered (1)-(7) are withdrawn in view of Applicants' current amendments to the specification, examples of further specification objections still remaining have been given above.

The previous objection to the claims, the previous rejections under the second paragraph of 35 U.S.C. 112, and the previous rejections under 35 U.S.C. 102 are each withdrawn in view of current claim amendments.

On page 19, Applicants request support for the previously indicated expectation that a polarization of incident exposure light in a direction at an angle of approximately 45° with respect to the first and second lengthwise mutually orthogonal directions of the mask opening would be expected to achieve a more uniform exposure of the resist underlying the first and second lengthwise mutually orthogonal directions of the mask opening. The teachings of Alkaisi et al. have not been disputed by Applicants and are again repeated above. The logical reason for the above expectation is a matter of simple linear interpolation between known data points. Linear interpolation has been a long-standing and notoriously well-known technique, as taught by Schrieber (US 4,623,977, col. 35 lines 3 and 12-14). Interpolation is also considered to be correct for linear phenomena, according to Chung et al. (US 2001/0052981, paragraph [0060]). Bentz states that linear interpolation may be the simplest, fastest, and most commonly implemented form of interpolation, which is based on a straight line relationship between two values, points, etc. Linear interpolation is a well-known mathematical operation that computes a value between two known values given the ratios of a distance from each known value to an intermediate value divided by the distance between the two known values [0002].

Application of linear interpolation to the instant claims can be illustrated as follows. For a mask having an opening with mutually orthogonal or perpendicular 1st and 2nd lengthwise directions so that a 1st lengthwise direction is at 0° and a 2nd lengthwise direction is at 90°, it is known from Alkaisi et al. that (A) polarization of the incident exposure light at 0° would yield no exposure (0%) intensity under the 1st lengthwise direction and full exposure (100%) intensity under the 2nd lengthwise direction of the mask opening, but that (B) polarization of the incident exposure light at 90° would yield full exposure (100%) intensity under the 1st lengthwise direction and no exposure (0%) intensity under the 2nd lengthwise direction of the mask opening. Since both the 0° polarization and the 90° polarization yield undesirably non-uniform and opposite resist exposures under the 1st and 2nd lengthwise directions of the mask opening, linear interpolation clearly and logically suggests to one of ordinary skill in the art that polarization at an angle half-way between 0° and 90° (or 45°) would be expected to provide equalized half exposure (50%) intensity under each of the 1st and 2nd lengthwise directions of the mask opening, in order to form a uniformly exposed pattern in the underlying resist (e.g., as taught by Naya, etc.).

Applicants' further arguments on pages 18-19 with respect to claims 1, 4, and 17-18 have been considered, but they are moot in view of the new ground(s) of rejection presented above, as necessitated by current claim amendments.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

John Ruggles
Examiner
Art Unit 1756

S. ROSASCO
PRIMARY EXAMINER
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